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hereby certify that to the best of my knowledge and belief the following is a true translation made by me of the text of PCT Application No. PCT/EP02002014751 in the name of Kronospan Technical Company Ltd.

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The invention relates to a construction element manufactured from wood particles such as fibres or chips. A method is specified for the manufacture of construction elements. In particular, the invention relates to boards made entirely or predominantly from wood fibres.

A method for the manufacture of a wood-fibre board is already known from the German specialist periodical HK 1/88, pp 74 to 75, "Manufacture of MDF-Boards". Boiled wood chips supplied to a so-called refiner. In the refiner, the wood chips are processed by means of grinding discs to form fibres, in fact, subject to the additional supply of temperature and pressure. The fibres are removed from the refiner by means of steam and transported via a line known as a "blow line". In this context, the steam pressure is approximately 10 bar. The temperature is approximately 150 to 160°C. Adhesive is added in the "blow line". Phenol resins, urea resins or mixed resins made from urea and melamine can be used as the adhesive. After the addition of adhesive, the "blow line" becomes wider. Turbulence is caused by this widening, and the adhesive is mixed with the fibres. The proportion of adhesive to fibres is approximately 22% by weight.

The "blow line" opens into the centre of a drying tube. The drying tube has a diameter of, for example, 2.60 m. Air is blown through the drying tube at a temperature of 160°C, with a maximum of 220 to 240°C. In the drying tube, the moisture is reduced from 100% to 8 to 11%. The resulting steam charged with non-aqueous substances is separated from the fibres in subsequent cyclones and released into the environment via chimneys.

The fibres provided with adhesive are supplied in the form of layers to a moulding machine, where the fibres are pressed in two phases. Initially, a

preliminary pressing takes place. The pre-pressed fibres are then compressed under high pressure with a supply of heat to form a board. Specialists in this field have determined that the boards split, if the temperature during pressing to form a board falls below 150°C, for example, to 140°C. During pressing, the temperatures are therefore typically in the region of 180°C.

Additional known details, which could be of interest for the manufacture of wood-fibre boards are outlined below. An adhesive-application device for the production of fibre boards is known from the specification EP 0 744 259 A2. A method for manufacturing boards from a timber material is known from the specification US 5,554,330. The document GB 791,554 discloses a method for mixing solid and liquid components. A device for the continuous application of adhesive to wood chips is disclosed in DE 41 15 047 C1. Continuous mixing of materials in the form of chips and fibres with bonding agents is disclosed in DE-OS 1956 898. The specifications PCT/IB98/00607 and WO 98/37147 disclose the recovery of adhesive from timber components. Preliminary steam-treatment methods are disclosed in DE-OS 44 41 017, US 11 17 95 and in the Danish patent No. 0302/97.

The object of the present invention is to reduce manufacturing costs.

The object of the invention is achieved by one of the methods claimed. A board manufactured according to the method comprises the features of the dependent claim.

According to general expert opinion, wood-fibre boards must be pressed at temperatures above 150°C, because it has been established, that temperatures below 150°C lead to defects in the surface. The boards split,

if the temperature falls below 150°C, and cracks appear. If a temperature of 150°C is exceeded during pressing, splitting is avoided as a result of an adequate hardening of the adhesives and/or resins used.

The inventors have established that it is exclusively the steam occurring at the high temperatures, which is responsible for the splitting. No splitting occurs, if steam is not produced at all, or, at least, if steam is produced only to a slight extent because of sufficiently low temperatures.

Surprisingly, it was also found that splitting can be avoided by selecting sufficiently low temperatures during pressing. It is important that no steam or only a small amount of steam is produced during pressing. Temperatures below 120°C have already proved adequate. The temperature range between room temperature and 95°C is preferred. By particular preference, pressing is carried out at temperatures up to 60°C. The rate of pressing is not influenced or hardly influenced by the supply of heat. However, a delay can occur in pressing, if, for example, the wood components are only brought up to temperature in the press. In this case, a delay occurs because heating requires time.

If the fibres with the resin are pressed at temperatures, for example, of 200°C, then the resins, which are typically used, harden completely or almost completely. The resin does not harden or hardens only to an insignificant extent, if it is pressed together with the wood chips, wood fibres, sawdust or mixtures thereof at temperatures below 120°C. A person skilled in the art was previously of the opinion that resin ought to harden so that a surface, which is free from defects, can be achieved in construction elements such as boards made from timber materials.

The resins used are initially present in the form of low-molecular weight components. Hardening means that the low-molecular weight components cross-link with one another, thereby forming a stable network.

The construction element manufactured according to the method differs from the prior art, in particular, in that the resins used are not hardened. The resin used can be detected in an unchanged or almost unchanged state by chemical analysis of the product. Accordingly, no chemical change and no chemical cross-linking or practically no chemical cross-linking has taken place.

The board manufactured at sufficiently low temperatures can, in particular, be used as a semi-finished product. In one embodiment of the invention, this board is fed into a press in a known manner together with décor paper, counteracting paper and other components of a laminate flooring. Pressing is then carried out at temperatures above 150°C, preferably above 180°C. The upper temperature limit is reached, when the temperature causes damage to the product.

In this manner, not only are the papers connected to the board, but the resins in the board are also hardened. Altogether, considerable cost savings are achieved, because one heating stage has been reduced or even completely eliminated.

A typical density of the board manufactured according to the invention is around 650 kg/m^3. The board should be pressed so strongly, that the density does not fall below 300 kg/m^3, preferably 400 kg/m^3, by particular preference 500 kg/m^3, in order to achieve a stable and therefore easily-handled board. The density of the board is typically below 1000 kg/m^3.

When the board is pressed to form the end product, for example, a coated board for laminate flooring, it can be compressed to a density above 1500 kg/m³, by particular preference to a density above 2000 kg/m³. Accordingly, the density in one exemplary embodiment is 2400 kg/m³.

The proportion of resin in the board is, for example, around 7.5% by weight, if the manufactured board is to be used as flooring in the form of panels. In the case of door panels, the proportion of resin is typically 2.5% by weight. To manufacture boards which satisfy the EN438 standard, the proportion of resin should not exceed 35% by weight. For economic reasons, the limit of approximately 10% by weight resin should not be exceeded. A lower limit at which the method still functions, is approximately 1% by weight.

The resins used are reactive resins, that is to say resins with components, which are chemically capable of forming a network. Examples of reactive resins include: solid or liquid phenol resins, amino resins, for example, urea resins, melamine resins, acrylic resins, epoxy resins and/or polyester resins.

In one embodiment of the invention, wood chips made from timber can first be separated into solid and liquid components. The solid wood components are dried and provided with adhesive, that is to say, reactive resins. The solid wood components provided with adhesive are then pressed to form a moulded body, for example, a board.

The liquid components comprise, in particular, lignin and hemicellulose. At the temperatures predominating during drying, these substances produce emissions, which cause odour pollution and therefore also environmental pollution. By separating these liquid components before drying, the corresponding emissions during and/or following drying are

reduced. Environmental pollution during the manufacture of the boards is reduced correspondingly.

The liquid components are preferably disposed of and/or further processed at temperatures, at which only minimal emissions occur. If the temperatures of the liquid components are high, in particular, if these temperatures are above 90°C, then the liquid components are held in a gas-tight system sealed from the environment until the temperatures have fallen sufficiently.

In a further embodiment of the invention, the liquid components, in particular lignin and hemicellulose, are used as an adhesive, that is to say, according to the invention, these components are mixed with the dried, solid wood components. The solid wood components are preferably further processed to form fibres or chips. The liquid components may, for example, be separated from the solid wood components in a so-called agitator. The components named above, are typically obtained in the following proportions: 20 to 35% by weight hemicellulose, 45 to 50% by weight cellulose and 20 to 35 % by weight lignin. The cellulose is a solid component of the wood.

In one embodiment, wood chips are first placed in a packing screw. From the packing screw, the wood chips are conveyed in a compressed condition to a boiling container where they are boiled under high pressure. The boiling container is therefore designed for high pressures. The pressure in the boiling container is, in particular, at least 1.2 to 2.2 MPa (12 to 22 bar). According to the prior art, wood chips are generally boiled at pressures of only 0.8 to 0.9 MPa. As a result of the steam-tempering treatment, the solid wood components (cellulose) are separated from the lignin and hemicellulose, which provide the liquid components. The cellulose is present in solid form. The two other components lignin

and hemicellulose are liquids and can, in principle, be used as an adhesive. The adhesive force in this case is achieved primarily by the hemicellulose.

It is, in fact, already known from the specification WO 98/37147, that the lignin and hemicellulose contained in wood can be separated from the solid components and subsequently used as an adhesive for the manufacture of MDF boards. However, the disadvantage with this method is the strong emissions, which pollute the environment around a production site. According to the invention, the problem of emissions is reduced, in that the liquid components are separated from the solid components of the wood in a gas-tight container. The liquid components are separated and initially remain, for example, within a gas-tight system connected to the container, in fact, at least while the temperatures of the liquid are sufficiently high to cause strong emissions. After the separation of the liquid components, these cool down to a significant extent and are only removed from the gas-tight system at relatively low temperatures, for example, for further processing, especially by spraying via nozzles onto the fibres. The liquid components are therefore significantly cooled, in particular, by at least 30°C, preferably by at least 50°C, before they leave the gas-tight and therefore also odour-tight, sealed system. In this relatively cool condition, the development of odour is significantly reduced. Removal of the liquid components from the gas-tight system is then non-critical.

The liquid components can be used as an adhesive. This is achieved in an environmentally-friendly manner in that the liquid components of a wood are only removed from a gas-tight and therefore odour-tight, sealed system at low temperatures, especially at temperatures significantly below 100°C, especially below 70°C, by a particular preference below 50°C, and applied to the fibres, for example, in this cool condition.

Environmental pollution can thus be reduced in a particularly economical manner.

The gas-tight system consists, for example, of the container together with the connected lines. A further container, which can be used, for example, for cooling, may also form part of the gas-tight system.

With a treatment according to the prior art, the adhesive is undesirably subjected to a temperature treatment in the drying tube. From approximately 80°C the adhesive is, in fact, disadvantageously stressed and/or activated. Activated adhesive can no longer be used for the subsequent processing stage, in which the glued, solid wood components are compressed to form the board.

With the prior art mentioned above, the active component of the adhesive is reduced. Of the original 22% by weight normally used, only 1 to 8% by weight is available for use, after the fibre-adhesive mixture is removed from the drying tube. According to the invention, the adhesive is applied to the solid wood components in a relatively cool condition. This avoids any unnecessary, premature and extensive activation of the adhesive.

An adhesive based on formaldehyde-urea is currently used in HDF boards, MDF boards and chip boards. Melamine is added to the adhesive, if the boards are to be used for flooring. This prevents swelling, which can occur as a result of moisture.

The problem here is that some of the adhesive is lost for the actual processing stage as a result of the temperature treatment. It is therefore a disadvantage that considerably more adhesive must be added to the fibres or the chips, than is necessary in order to press the fibres or the chips in a press with a supply of heat and in order to achieve the desired outcome,

such as, an MDF board. At present, an MDF board can contain approximately 60 kg of adhesive per m^3. This quantity can be considerably reduced, if the adhesive is applied in a relatively cool condition.

In one embodiment of the invention, the liquid components, hemicellulose and lignin, obtained in the manner described above, are applied as an adhesive to the solid wood components in a cooled or cool condition. In the cooled or cool condition, these components can advantageously be mixed with another adhesive. In this case, the other adhesive is not obtained from the liquid components of the wood. The proportion of hemicellulose and lignin in the adhesive mixture prepared in this manner is preferably no more than 20% by weight. Furthermore, the mixture especially contains an adhesive based on formaldehyde-urea. Moreover, the adhesives specified in the prior art can be used.

If an adhesive mixture, which contains more than 20% by weight hemicellulose and lignin, is used, then the pressing time (with a supplementary use of currently available, conventional synthetic adhesives), during which the glued fibres are pressed to form a board, is relatively long. It is therefore more economical, to mix the hemicellulose and lignin with another adhesive or adhesive mixture. On the one hand, conventional adhesive can be saved, and on the other hand, the method is not relatively prolonged, thereby becoming less economical, because of the long pressing times. The economically meaningful upper limit for the proportion of hemicellulose and lignin is dependent upon the reactivity of the adhesive, with which the hemicellulose and lignin components are mixed. The named upper limit of 20% by weight therefore merely represents a guide value or respectively a value based on current experience.

In one embodiment of the invention, the solid wood components are first dried, and adhesive is then mixed with the dry components at temperatures, which are considerably lower than the drying temperatures, in particular below 100°C. This avoids exposing the adhesive to undesirable, relatively hot temperatures, which occur during drying.

With the prior art, the adhesive also contributes to emissions. Since the adhesive is now no longer exposed to hot drying temperatures, but is applied to the solid wood components at relatively cool temperatures, emissions originating from the adhesive are also avoided. In the drier and/or drying tube, only water but not chemicals are dried. Corresponding environmental advantages result from this, because the dry air is not disadvantageously charged with vapours originating from the adhesive, as in the prior art. The manufacture of the boards is therefore more environmentally friendly. This embodiment has the additional advantage that proportions of the adhesive are not disadvantageously activated during the drying process and therefore unavailable for the actual gluing of the wood components to form the board.

The solid wood components, which are present particularly in the form of fibres or chips, and which are dried, are also advantageously not charged with liquid components of the wood material and, in the embodiment named above, also not charged with adhesive. The corresponding liquid phases are therefore also not dried in the drier. By comparison with the prior art, considerable energy savings are achieved. The saving of energy not only leads to considerable cost advantages, but also protects natural resources and therefore the environment.

Because the adhesive is only applied to the wood components after drying, the quantity of adhesive required for the manufacture of the

boards is reduced. A reduction to 45 to 55 kg/m^3 board can be achieved. A typical value is around 50 to 52 kg/m^3 of board.

One essential parameter in order to achieve a suitable gluing of fibres or chips is the "correct" ratio of the solid wood components to the adhesive. In one embodiment of the method according to the invention therefore, the solid wood components are supplied to a belt weighing machine before the application of the adhesive. On the belt weighing machine, the solid wood components are not only transported by means of a circulating conveyor belt, they are also weighed. As a result, information is obtained regarding the quantity of adhesive to be added to the solid components of the wood in the following stage.

The solid wood components are transferred to the subsequent device by means of the belt weighing machine. In one embodiment, possible fluctuations in the weight of the solid wood components supplied are measured, registered and stored during transport. These data are prepared and can be used as parameters for adjusting the quantity of adhesive, which is subsequently applied to the solid wood components.

In one embodiment of the invention, the rate of transport on the belt weighing machine is controlled in such a manner that a uniform quantity of solid wood components is supplied to the downstream adhesive-application device (in which the solid wood components are provided with adhesive). By changing the rate of the feeder, a constant quantity of material can be supplied to the downstream devices. The weight of the solid wood components, which may be present in the form of fibres or chips, can be registered in extremely small steps. This allows a uniform supply of the solid wood components with an accuracy, for example, of ±1%.

It is not easy to provide the solid wood components with adhesive in a uniform manner, especially if the solid wood components are present in the form of fibres. Fibres have a tendency to clump together in the form of a wad. It is then difficult to distribute the adhesive uniformly on the fibres. In one embodiment of the invention, the application of the adhesive is carried out in a mixer, in which the adhesive and the solid wood components are mixed with one another.

In one embodiment of the invention, the mixer provides means for cooling its housing. For this purpose, in one particularly simple embodiment, an at least partially double-walled housing, for example, a double-walled tube, which forms a part of the housing of the mixer, is provided. A cooled liquid, for example, cooled water, is supplied through the double-walled housing, in order to cool the mixer or respectively its walls. As a result of the cooling, a layer of condensation water is formed on the walls. The cooling is designed accordingly. As a result of the layer of condensation water, solid wood components provided with adhesive do not adhere to the walls and clog the mixer.

After drying, the solid wood components are spread, according to one embodiment of the invention, in a flat manner, forming a type of curtain or mat. This is especially appropriate if the solid wood components are present in the form of fibres, because a mat and/or a curtain can readily be formed from fibres. Adhesive is then added, in particular, sprayed onto the curtain. By preference, an air-adhesive mixture is sprayed, in order to guarantee the most uniform possible distribution of the adhesive. As a result of the formation of a curtain, the adhesive is distributed uniformly on the solid wood components. This is particularly appropriate if the solid wood components are present as fibres.

In one embodiment, a curtain or mat formed from solid wood components is fed into the mixer. An air-adhesive mixture is then blown through nozzles onto the curtain or mat. The adhesive is therefore supplied to the curtain or mat via the nozzles. Following this, the curtain or mat is transported through the mixer preferably in a contactless manner. Contactless transport advantageously prevents the adhesion of the solid wood components to the walls. Problems of contamination and the associated costs are therefore reduced.

Together with air, the adhesive is blown into the dried solid wood components, especially at a temperature from 40 to 70°C, preferably at a temperature from 55 to 60°C. This means that the adhesive reaches a dry exterior skin. Accordingly, it is activated only to a minimal extent. As a result, the subsequent mixture of solid wood components and adhesive does not adhere to transport equipment and devices, for example, in the interior of the mixer.

Because the adhesive is exposed to considerably lower temperatures than hitherto, it is possible to use more reactive adhesives by comparison with the prior art. Moreover, it is possible to reduce the proportion of chemicals such as formaldehyde. This leads to further environmental advantages.

In one embodiment of the invention, the adhesive is brought into turbulence with heated air, and this air-adhesive mixture is supplied to the dried, solid wood components, for example, fibres or chips. The heated air, which is supplied to the mixer, for example, together with the adhesive and the dried, solid wood components, via a cabin or cell, to a certain extent activates the surfaces of the adhesive droplets formed in this manner. As a result, an adhesion of the solid wood components to downstream devices, for example, to the walls of the mixer, is

appropriately prevented. Otherwise, the mixer would have to be cleaned, for example, after very short intervals, thereby disadvantageously interrupting production. Undesirable cleaning costs would also be incurred. Regarding the disadvantage, that the adhesive is slightly activated, the considerable economic disadvantages referred to above must be evaluated and weighed against one another. With a few experiments, a person skilled in the art can determine the extent, to which the surface of the adhesive should be activated in order to achieve an optimum economic result. The proportion of activated adhesive will always be small by comparison with the prior art.

In one embodiment of the invention, in order to facilitate subsequent processing stages, the free surface of the adhesive is somewhat further activated after the adhesive has been added to the dried solid wood components such as fibres or chips by means of a device suitable for this purpose. After the adhesive has been added to the dried, solid wood components, that is, to the fibres or chips, especially after leaving the mixer, the solid wood components provided with the adhesive are preferably conveyed into an ascending pipe, which is, in particular, 10 to 30 m long, by preference, approximately 20 m long. The diameter of the ascending pipe is, in particular, from 1 to 4 m.

The ascending pipe is preferably also cooled and is, for example, also double walled in order to allow a flow of cooling liquid between the two walls. Once again, the aim is to form a layer of condensation water on the interior walls of the ascending pipe, so that the glued solid wood components do not adhere to the walls.

The glued, solid wood components can be conveyed through the ascending pipe in a particularly simple, contactless manner, by means of an air or gas flow.

It has been shown that the solid wood components, especially if these are present in the form of fibres, should be conveyed through the ascending pipe at a rate of at least 25 m per second, preferably at least 35 m per second. At a slower rate, the fibres or chips would adhere more intensively to the ascending pipe in spite of the measures mentioned above. As a result, the ascending pipe would be contaminated unnecessarily quickly. With slower rates, the ascending pipe had to be cleaned after 8 hours. By adjusting an appropriate rate, the cleaning cycles were extended to 7 to 8 days. Accordingly, the ascending pipe need only be cleaned once a week.

The maximum rate, at which the solid wood components provided with adhesive are blown through the ascending pipe, depends upon the performance of the equipment and/or devices downstream. In this context, it must be taken into consideration that the downstream equipment and/or devices must be capable of processing the incoming quantity of solid wood components. In practice, at present, an upper limit of 40 m per second can be realised without difficulty. From 50 m per second, currently used downstream equipment was overloaded. The upper speed limit can be increased, as soon as downstream equipment of higher performance is available. In principle, faster transport rates in the ascending pipe are advantageous, because problems of contamination and the associated interruption of production are reduced accordingly.

Providing an ascending pipe means that the adhesive is further activated to some extent on the surface, in order to allow the implementation of downstream processing stages in an appropriate manner. The length of the ascending pipe should therefore be adapted by the person skilled in the art to the desired degree of adhesive activation. The person skilled in the art

will take the rate of transport through the ascending pipe into account within the design process.

Following the addition of adhesive to the dried, solid wood components, in particular, following the partial activation of the adhesive in the ascending pipe, the solid wood components, which are provided with adhesive, are transported into a cyclone. Here, the surface of the adhesive has been activated adequately as a result of the measures named above, so that it does not adhere in the cyclone. In the cyclone, the solid wood components are separated and transported to the next processing stage by a transport means such as a conveyor belt. The solid wood components are separated from the air in the cyclone. In one embodiment, the transport means conveys the solid wood components into a screening device. In the screening device, the solid wood components are screened for coarse components. Any coarse components are automatically removed. Coarse components include, for example, lumps of adhesive.

From the screening device, the solid wood components are transported by a belt to the press, where they are compressed to form a board. The press preferably consists of circulating compression belts pressed against one another, which are tempered appropriately. This allows continuous pressing. The temperature should be adjusted for the relevant adhesive by a person skilled in the art. According to one embodiment, the quantity of energy and the resulting temperatures for the two compression belts are selected to be different, in order to prevent a distortion of the board manufactured. However, according to the invention, a tempering of the press can also be completely omitted.

In one embodiment of the invention, the nozzles through which the adhesive is supplied to the solid wood components are preferably designed to be conical. The adhesive then emerges from the tip of the

cone in the form of droplets, thereby advantageously promoting and improving a uniform distribution of the adhesive.

To avoid cleaning work and an associated interruption of production, attention should be paid to the fact that the adhesive emerging, for example, from nozzles, does not come into contact with downstream tools, such as tools disposed in the mixer. The adhesive is therefore preferably directed, in particular, sprayed, towards the solid wood components in order to achieve the most uniform possible distribution. Moreover, it is particularly important to ensure an adequate distance between the nozzles and the tools downstream in the mixer. In practice, it has been shown that the distance between the tools in the mixer and the nozzles should be at least 1 m, preferably at least 2 m, if the adhesive is sprayed in a horizontal direction. The solid wood components are then introduced vertically at the start of the mixer and further transported within the mixer in a horizontal direction. The actual distance values named relate, of course, only to an individual exemplary case. They are not generally applicable, because these values are ultimately dependent upon the rate, at which the adhesive emerges from the nozzles.

If an air-adhesive mixture is sprayed towards the solid wood components, an air stream, by means of which the solid wood components can be blown and therefore transported, initially with the minimum possible contact, through the downstream devices such as a mixer or an ascending pipe, is advantageously provided at the same time. Another gas may in principle also be used instead of air.

Stirring devices, which achieve a mixing of the solid wood components with the adhesive are used, in particular, as the tools within the mixer.

To achieve good results, the solid wood components are brought in front of the nozzles in the form of a curtain. Accordingly, in addition to the advantages already named, this prevents the adhesive from being sprayed into the mixer and contaminating the tools disposed there. Otherwise, the solid wood components would adhere to the tools, and the mixer would become clogged in a very short time and would have to be cleaned in short intervals.

In one embodiment, the tools in the mixer are attached to a centrally mounted axis and consist of rods projecting in a star-shape, each of which merges into a flat region similar to the blade of a paddle. Altogether, each star is formed, for example, by four tools. Two tools respectively enclose an angle of 90°. The blades of the paddles are positioned diagonally relative to the air stream, which flows through the mixer. As a result, a turbulence is created in the air, thereby providing a good mixing of the solid wood components with the adhesive. Several "stars" formed by the tools are attached to the axis at regular intervals. The solid wood components are then transported through the mixer parallel to the axis. In general, the tools are specially designed to cause turbulence in the air near the solid wood components. Propeller-like tools or tools acting as propellers are therefore preferred.

A curtain is preferably formed from the solid wood components as follows.

A transport means, such as a conveyor belt and/or a belt weighing machine, is provided with at least one roller, preferably more than one, roller at the end. The solid wood components are passed through the roller(s). In particular, the rollers are pressed against one another. A gap remaining between two rollers, or between one roller and an adjacent surface, is, in principle, unproblematic. A kind of curtain or mat is

formed from the solid wood components as they pass through the rollers. The form of a curtain is therefore created by the rollers.

In this context, a conveyor belt is used by preference, because this guarantees a uniform supply of solid wood components, which are especially provided entirely or predominantly in the form of fibres, to the rollers. In one embodiment, a belt weighing machine is used to control the rate of supply to the rollers, thereby supplying a particularly constant quantity of solid wood components to the rollers. According to the prior art, worm screws are routinely used for the transport of solid wood components in the manufacture of boards. However, the solid wood components leave the worm screws in a relatively uneven manner. This would form a correspondingly uneven curtain from the solid wood components. A curtain of uniform thickness and width is advantageous in order to achieve a uniform distribution of adhesive. This also means that the curtain reliably separates sprayed adhesive from downstream tools.

In particular, rollers compressed together or with a gap between them for the production of the curtain, prevent the solid wood components, especially if these are present entirely or predominantly in the form of fibres, from being transported in a wad-like or clump-like manner. This would impair the desired uniform application of adhesive.

In one embodiment, in order process a sufficiently large quantity of solid wood components to form a curtain and to achieve a particularly uniform curtain, more than two rollers, through which the solid wood components are guided to form a curtain, are provided. The rollers are preferably arranged above one another offset in such a manner that an acute angle is enclosed between the rollers and a transport medium, for example, a conveyor belt and/or belt weighing machine. Accordingly, sufficient material can be supplied to the transport medium, for example, the belt

weighing machine, in order to process a sufficiently large quantity of solid wood components in a uniform manner.

It has already been shown in practice, that a total of four rollers is particularly advantageous in order to create a curtain from the solid wood components, to which adhesive is subsequently applied by mechanical means.

The opening, through which the curtain consisting of the solid wood components is guided into or in front of the mixer, preferably corresponds to the maximum width of the mixer housing, for example, the diameter of the named tube, which at the same time forms the walls of the mixer. This ensures that the entire width of the mixer is covered by the curtain. Otherwise, adhesive could be sprayed into the interior of the mixer through the remaining openings at the sides of the curtain, and the problems of contamination mentioned above would occur.

If the entire width of the mixer was not covered, adhesive would not only be sprayed into the mixer, but any solid wood components disposed at the edge would be drawn along more strongly and could form clumps. This would impair the quality of the material and could lead to corresponding production problems. The material would have to be re-processed in a disadvantageous and cost-intensive manner.

In practice, the lateral walls of the mixer are preferably cooled to 7 to 15°C, especially to 10 to 12°C. This means that a layer of condensation water is deposited on the walls. Adhesion to the walls is avoided by the layer of condensation water.

The temperatures named above are also suitable for the formation of a layer of condensation water on the interior walls inside the ascending pipe.

Since a gaseous medium such as air is provided, inter alia, for the transport of the fibres with the adhesive through the mixer, the nozzles for supplying adhesive, in one embodiment of the invention, are disposed at a distance from the housing of the mixer. The nozzles in this case are disposed in front of an opening of the mixer housing. A gap or an annular gap, through which air is drawn and can therefore be supplied in an appropriate manner, then remains between the nozzles and the opening. Moreover, with this embodiment, air, which is introduced via the gap or annular gap, can be pre-heated in order to achieve a desired temperature in the mixer, especially to promote a desired activation of the adhesive at the surface.

In one embodiment, tools in the interior of the mixer are attached to an axle. The nozzles for supplying the adhesive in this case are arranged in a ring around the axle, in order to supply adhesive to the fibres in a uniform manner. The fibres or respectively the curtain consisting of fibres are/is then preferably transported perpendicular to the axle between the nozzles and the tools. In dependence upon the diameter of the mixer, the nozzles are arranged in a ring of one or more rows. With a correspondingly large diameter, the entire opening of the mixer is sprayed with adhesive by arranging a second row of nozzles in a ring shape around the axle.

In one embodiment of the invention, glass fibres or synthetic-material fibres are added in addition to the fibres consisting of solid wood components. These fibres are added especially in the mixer or immediately in front of the mixer. As a result, particularly good, board-

like, moulded parts can be manufactured, for example, as an interior lining in a motor vehicle. Moulded boards of this kind can be used in the automobile industry, for example, as a hat shelf. In this context, it is sufficient if the layer system is subjected only to preliminary pressing. A final pressing need not be carried out.

The automobile industry does not require moulded parts in a quantity comparable with the normal, economical production of fibres on a large industrial scale. It is therefore more economical to manufacture moulded parts, especially for use in the automobile industry, together with MDF boards (for the manufacture of panels), in order to utilise the quantities of fibre on a large industrial scale. The wood-fibre boards provided for the manufacture of panels have an upper side and a lower side, which run parallel to one another and are flat. These boards are a few millimetres thick. They do not generally contain synthetic-material fibres or glass fibres, because no special forms, differing from a flat surface have to be realised.

In manufacturing moulded parts, sharp edges, for example, as specified in the German specialist periodical HK 3/88, page 278, are problematic. Sharp edges are susceptible to damage. Problems of this kind can be avoided or significantly reduced by reinforcement with glass fibres or synthetic-material fibres.

Moulded parts of the type named are also used in the furniture industry. Moulded parts of this kind are required, for example, for doors, which are shaped in a special manner for design reasons.

By contrast with boards consisting of fibres, for example, MDF boards or HDF boards, which are used as the carrier board for flooring panels, moulded parts, need only be subjected to preliminary pressing.

Preliminary pressing is carried out at considerably lower pressures than the final pressing stage. The preliminary-pressing pressure may be only one third of the pressure used in the final pressing stage. The final pressing stage can be carried out at pressures from 75 to 80 kg/cm^2.

The proportion of glass fibres and/or synthetic-material fibres in a moulded part is up to 25% by weight, preferably up to 15% by weight, in order to achieve cost favourable results. At least 1% by weight, by particular preference, at least 5% by weight of glass fibres should be used.

Even regardless of the other named measures and features according to the invention, separating the wood fibres, which are used for the manufacture of MDF boards or HDF boards for panels, especially flooring panels, from the wood fibres for the manufacture of moulded parts, is particularly economical by comparison with the prior art.

In a further embodiment of the invention, solid wood components provided with adhesive are arranged in a layer – for example, on a conveyor belt – and charged with hot steam, for example, by steam shock. Following this, the layer is compressed in a press – for example, between two circulating belts pressed against one another - to form a board. The invention is particularly appropriate for the manufacture of fibre boards.

In one embodiment, the two main exterior surfaces of the layer are treated with steam from the outside. This can be carried out at the same time as a preliminary pressing or compacting of the layer. For example, the layer of solid wood components are transported between two rigid plates by means of a steam-permeable conveyor belt. One plate is disposed below the conveyor belt while the other plate is disposed above

the conveyor belt. The distance between the two plates can be reduced in the direction of transport, thereby compressing the layer. The layer is charged with steam via nozzles disposed in the plates. The moisture in the surface region of the layer is then increased, especially by at least 2% by weight, for example, up to 4% by weight, and therefore, for example, from 7% by weight up to 9 to 11% by weight. The temperature of the steam is typically 100 to 130°C.

As a result of the steam treatment, the thermal conductivity is increased towards the middle of the layer. Overall, this improves the pressing performance and therefore reduces the pressing time.

In one embodiment, the layer or the already-compacted layer made from solid wood components provided with adhesive can be split to form, so to speak, two layers one disposed above the other. For this purpose, the layer is transported, for example, on a conveyor belt. A strip or rail is arranged above the conveyor belt and transverse to the conveyor belt, in such a manner that it splits the layer disposed on the conveyor belt. A steam treatment device, which is disposed in this manner between the two layers, is connected to the strip or the rail. The adjacent sides of the two layers resulting from the splitting, or at least one of these, is steam treated as described above, in order to allow a more rapid pressing time. Following this steam treatment, the upper layer is disposed on the lower layer. The steam treated layers are transported into the press and compressed here to form a board.

The steam treatment means that a direct or indirect rapid heating of the fibres provided with adhesive takes place directly before and/or during pressing.

When manufacturing panels for flooring, it is important that the panels provide hard outer layers and a soft inner layer. As a result, footfall noise, for example, can advantageously be reduced. If the surface is steam treated in a targeted manner, and the interior region remains relatively dry, then the surfaces are compressed in a targeted manner. The cause for this is, inter alia, that moist material can be compressed better than dry material. In this manner, the surface regions are therefore compressed in a targeted manner. The preliminary steam treatment, also allows a control of the temperature course. Accordingly, harder outer layers by comparison with the middle layer can be achieved in an improved manner.

Furthermore, additives, which contribute to the hardening, can be added to the steam. In this manner, the desired hard surfaces can be improved, if the surfaces are steam treated before pressing.

If harder covering layers are present, these may be relatively thin. Overall, material can therefore be saved with the same board thickness, because the soft middle layer is manufactured from comparatively less material.

The invention will now be described in greater detail with reference to the following diagrams.

Figure 1 shows a section through a belt weighing machine 1 with a mixer 2 located downstream. As indicated by the arrow 3, dried fibres, which have been manufactured from wood chips, are supplied to the belt weighing machine 1 via an opening of the housing 4. A bevel 5 guides the incoming fibres towards the belt of the belt weighing machine.

The belt weighing machine registers and controls the quantity of material, which is transported towards the three rollers 6. The three rollers 6 are arranged above one another and offset in such a manner that they enclose an acute angle alpha with the belt weighing machine 1. The fibres disposed on the belt weighing machine are conveyed into this acute angle. They pass the rotating rollers 6. Accordingly, a curtain is formed from the fibres, which is transported perpendicularly downwards along the arrow 7 subject to the force of gravity. In this manner, the curtain enters the mixer 2 between a plurality of nozzles 8 and tools 9.

The mixer consists of a tubular housing. The housing is formed by a double wall 10 and 11. An axle 12, to which the tools 9 are attached, is arranged centrally in the interior of the housing. A tool 9 encloses a right angle with the axle 12. In each case, four paddle-like tools 9 are combined in a star shape. Several of these combined tools are attached at uniform intervals to the axle 12. The front region, into which the curtain consisting of fibres is introduced, is free from tools. This ensures a sufficiently large distance between the tools 9 and the nozzles 8. This distance is required so that the adhesive sprayed from the nozzles 8 does not strike the tools directly during operation.

The diameter of the housing of the mixer corresponds to the width of the opening, through which the curtain consisting of fibres is introduced into the mixer. The width of the curtain is adapted to the width of the opening. The nozzles 8 are arranged in an upper region in a semicircle around the axle 12. As a result, on the one hand, the curtain is uniformly provided with adhesive and, on the other hand, the adhesive emerging from the nozzles 8 does not strike parts of the mixer directly. A gap is provided between the nozzles 8 and the housing 10, 11, thereby forming a type of annular gap. Air is drawn in through this annular gap. Means for heating the air drawn in are not shown in the diagram. Accordingly, an

air-adhesive mixture is formed. The curtain (in other words, a mat formed predominantly or entirely of fibres) provided with adhesive is transported by the air stream through the mixer 2 parallel to the axis 12. The axle and also the tools 9 rotate during transport. At this stage, the adhesive is further mixed with the fibres. A cooled liquid is passed between the two walls 10 and 11 of the double wall to cause the formation of layer of condensation water on the interior walls in the interior of the mixer.

Figure 2 shows a front elevation of the mixer parallel to the axle 12. For reasons of simplicity, only two tools 9 are shown. In particular, Figure 2 shows a single-row, semicircular arrangement of nozzles in the upper region.

Figure 3 shows an overview of an embodiment of the method.

Deciduous or coniferous timber in the form of trunk, branches and/or wood from saw mills and industrial timber is used as the starting material. The wood is first cut into wood chips of approximately 20 x 5 mm in a shredding device 31. These wood chips can also come directly from the plantation or from saw mills. The chips can be screened in order to separate excessively small or excessively large particles. When the chips have been sorted to the correct size, they can be washed to remove adhering foreign matter, (especially, sand and earth). This protects and prevents damage to cutting equipment and other tools in downstream manufacturing and processing stages.

Sawdust, which is provided in a silo 32, can advantageously be re-used.

The wood components are conveyed by means of conveyor belts from the shredding device 31 and from the silo 32 to a funnel-shaped preliminary-steam-treatment container.

The supply is typically in the proportion of approximately 6:4 (60% by weight wood chips; 40% by weight sawdust). In this manner, sawdust is also re-used. This allows a further reduction of costs, because supplies of raw material are saved. The proportion of wood chips should predominate, because fibres and, at a later stage, fibre mats can be formed from these wood chips, thereby providing mechanical stability. A lower limit for the proportion of sawdust does not therefore need to be observed.

In the preliminary steam treatment container 33, the wood components are mixed, subjected to preliminary steam treatment and heated to 60 to 70°C. The wood components are then supplied to a boiler 34, for example, by means of a packing screw. In the boiler 34, the wood components are boiled for approximately 2 to 3 minutes at a pressure of 11 to 16 bar and a temperature from 140 to 180°C. Pressure and temperature are selected in such a manner that a separation into liquid and solid wood components takes place.

The liquid components are separated from the solid components and fed into a line 35, which is connected to the boiler 34 in a gas-tight manner.

The solid wood components are supplied to a fibre refining machine 36 (refiner or defibrator). The fibre refining machine 36 typically comprises a stator and a rotor, which are driven by a motor. Here, the solid wood components are broken down into fibres.

The fibres, which in one embodiment are mixed with sawdust, are fed pneumatically to a drying tube 37. Reference is made to fibres in the following paragraphs regardless of the above. In the drying tube 37, the fibres are dried at 160 to 220°C. The drying takes place relatively quickly and in a cost favourable manner, because the liquid wood components have already been removed.

From the drying tube, the fibres are transported into cyclones 38, where the steam is separated. The fibres are removed from the bottom. The temperature of the fibres is then typically 50°C. Adhesive is then applied mechanically at comparatively cool temperatures to the fibres in adhesive-application devices 39. The subsequently glued fibres typically have a temperature of 35 to 40°C.

The glued fibres are then transported into one or more screening devices 40. In one embodiment, the screening devices 40 comprise heating devices to heat the fibres to 55 to 60°C. Increasing the temperature is advantageous if the boards are to be pressed, for example, at temperatures of 80°C. The pressing stage can therefore be accelerated, because the desired temperature need not be reached exclusively by means of the heated press. Shorter pressing times lead to increased production capacity or smaller procurement costs for the presses with circulating belts, because these belts can then be shorter. The space requirement for presses of this kind is smaller, which also helps to reduce costs.

The pre-glued fibres are then supplied to one or more separating devices 41. From the separating devices 41, the pre-glued fibres are transported to a spreading station 42. The spreading station 42 places the pre-glued fibres on a conveyor belt. The conveyor belt transports the fibres to a preliminary press 44. Here, the fibres are subjected to preliminary pressing being compressed in this manner. The preliminary press

comprises circulating belts, between which the fibres are passed and therefore compressed. Following this, the fibres pass through a moulding tract 45, which comprises various devices, which ensure that the fibres are present in the desired form. In one embodiment, the moulding tract leads towards a steam treatment device 46. Here, the fibres are treated with steam from above and/or below. The fibres can be split parallel to the conveyor belt so that they can be steam-treated in the "interior".

Finally, the fibres are transported to the main press 47, which consists of two circulating steel belts pressed one against the other. Pressing takes place here, for example, at 80°C.

The boards are then sawn by means of a sawing device 48 and transported to a holding device 49. In the holding device, the boards are held in such a manner that they do not touch. The boards are cooled in this manner.

The separated liquid components, which are supplied to the line 35, are cooled within the gas-tight sealed system. When these liquid components have been sufficiently cooled, they are either disposed of or supplied to the adhesive-application device 39.

Following this, the boards are further processed, for example, to form panels. The boards may then, for example, be coated with papers and the layer system supplied to a press. In the press, the layer system is compressed at temperatures above 150°C, for example at temperatures between 180°C and 230°C. The resins used then harden. The board is further sawn and provided with connecting elements by milling. The panels can be used as a covering for walls or floors. If they are used as a floor covering, the panels are provided on the upper, decorated side with an abrasion-resistant, transparent layer.